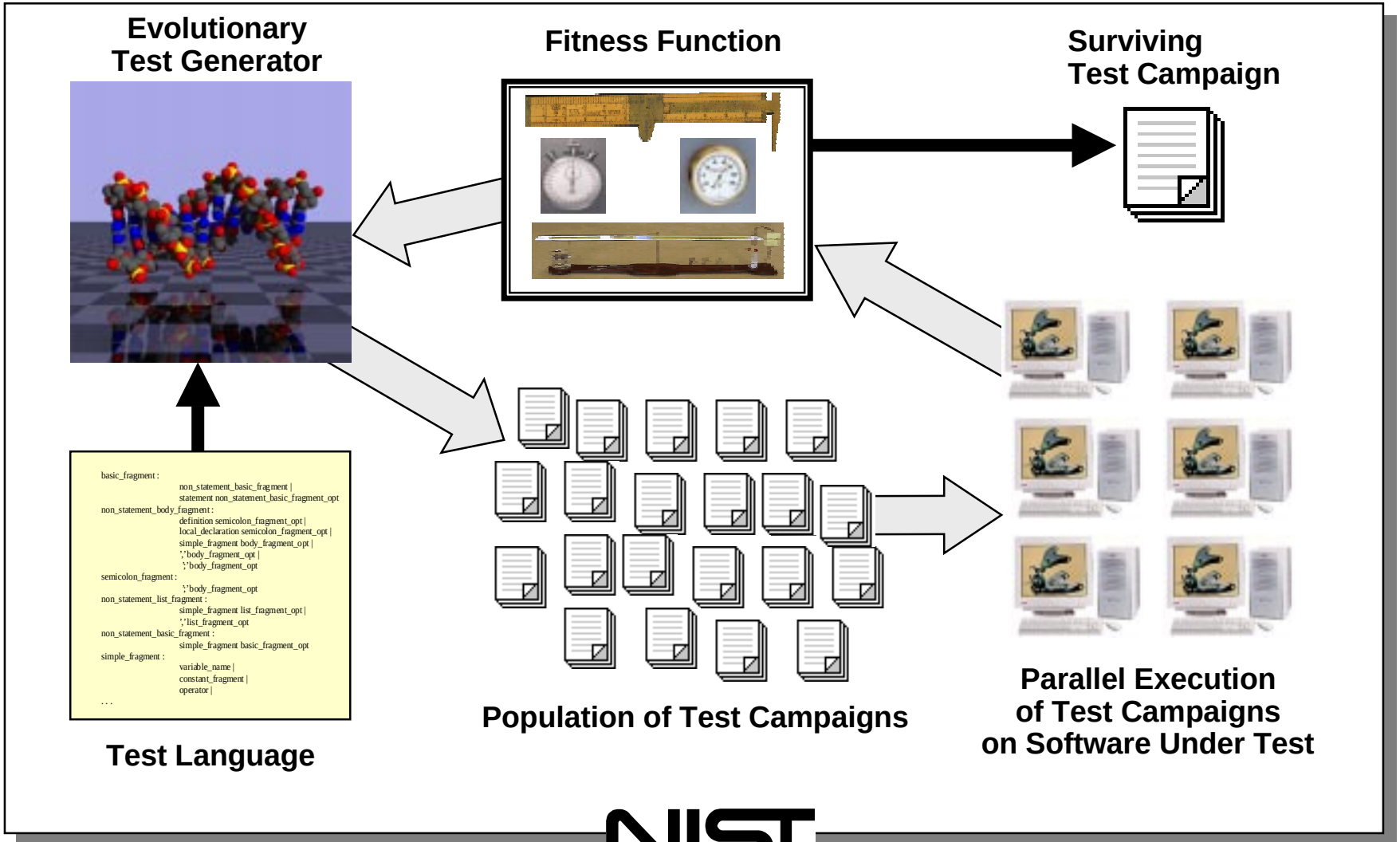
Rapid Evolution of Software Tests

Kevin L. Mills

Information Technology Laboratory

Rapid Evolution of Software Tests (REST)



Rapid Evolution of Software Tests (REST)

Goal: **Develop software to automatically generate measurably effective tests for information technology standards.**

New Ideas

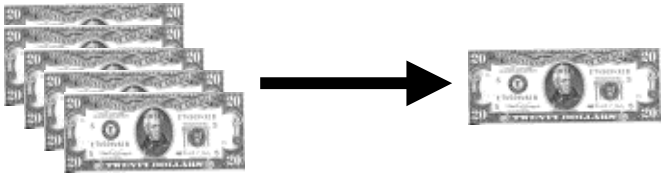
- **Use evolutionary algorithm to generate tests from test language.**
- **Evolve automatically from previous best tests to generate tests when system changes.**
- **Use software test coverage against reference implementation to evaluate tests.**
- **Execute generated tests in parallel on network of workstations.**

Rapid Evolution of Software Tests (REST)
RESEARCH ISSUES

- **Identifying Effective Genetic Operators**
  - **Cross-over: single slicing versus multiple slicing and recombination of slices versus riffling recombination**
  - **Mutation: statement mutation, sequence insertion, or sequence deletion**
- **Discovering Effective Genetic Representations**
  - **Structure: sequences or trees of sequences**
  - **Code: binary or syntax-driven**
- **Evaluating Alternative Fitness Functions**
  - **Coverage Metrics: code coverage, data-flow coverage, or mutation coverage**
  - **Other Metrics: cost and combinations of coverage and cost**

Rapid Evolution of Software Tests (REST) IMPACT

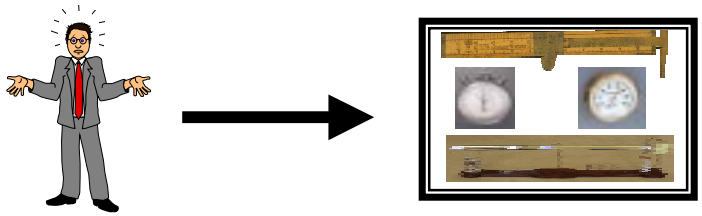
REDUCE COST TO TEST SYSTEM



Practice: 25-50% Cost of Software

Goal: 5-10% Cost of Software

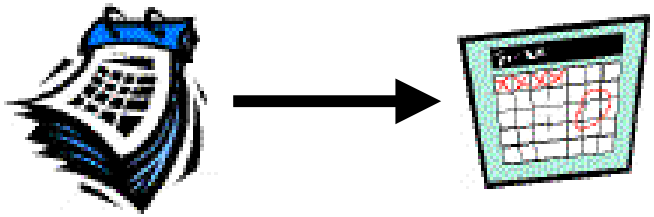
IMPROVE QUALITY OF TESTS



Practice: Test Suite Composition is a Judgment Call

Goal: Coverage and Cost Metrics Used to Evaluate

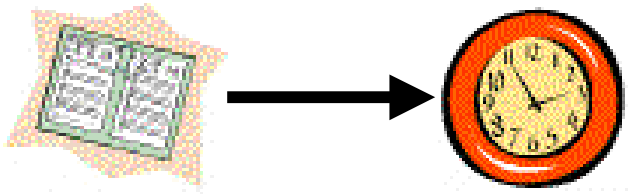
REDUCE TIME TO TEST AVAILABILITY



Practice: Months to produce tests

Goal: Days to produce tests

REDUCE TIME TO ADAPT TESTS



Practice: Weeks to revise tests

Goal: Hours to revise tests

NIST

Rapid Evolution of Software Tests (REST)
SCHEDULE

YEAR 1 - BUILD PROOF-OF-CONCEPT PROTOTYPE

Deliverables:

- **Prototype evolutionary test generation software**
- **Demonstration of application to test a real-time application of 2.5KLOCs**

Decision: Generated tests achieve at least 90% branch coverage.

YEAR 2 - EXPLORE GENETIC OPERATORS AND FITNESS FUNCTIONS

Deliverables:

- **Robust evolutionary test generator software**
- **Evaluation of various genetic operators and fitness functions**
- **Demonstration of application to an ITL problem**

Decision: Generated tests achieve feasible coverage against selected ITL problem.

YEAR 3 - APPLY TO INDUSTRIAL-STRENGTH PROBLEM

Deliverables:

- **Final evolutionary test generator software available for download**
- **Demonstration of application to an industry problem**

NIST

Rapid Evolution of Software Tests (REST)
RESOURCES

YEAR 1 - BUILD PROOF-OF-CONCEPT PROTOTYPE

1 Staff Researcher
2 Half-time programmers

Access to Network of Workstations

YEAR 2 - EXPLORE GENETIC OPERATORS AND FITNESS FUNCTIONS

2 Staff Researchers
2 Half-time programmers

Access to Network of Workstations and Available ITL Problem

YEAR 3 - APPLY TO INDUSTRIAL-STRENGTH PROBLEM

1 Staff Researchers
2 Full-time programmers

Access to Network of Workstations and Available Industry Problem